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OSTP and Next Generation Internet initiative

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Details

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Introduction

Mr. Chairman and Members of the Committee, I am pleased to appear before you today to discuss how the Office of Science and Technology Policy's (OSTP) provides leadership for the Next Generation Internet (NGI) initiative, a critical element of our efforts to help advance the frontiers of information technology.

NGI: Purpose and Goals

The Next Generation Internet (NGI), a Presidential initiative announced just over a year ago (October 10, 1996), is an advanced research program which fosters partnerships among academia, industry and Federal laboratories to develop and experiment with technologies that will enable more powerful and versatile information networks of the 21st century. The program's overall objective is to perform fundamental research in technologies that will accelerate the development of a high-speed, high-quality network infrastructure to support revolutionary applications. It is not, as some have mistakenly believed, a program to deploy network infrastructure. Our aim is to work in partnership with the university community to undertake fundamental research and to provide opportunities to demonstrate new technologies and applications in support of national goals and key Federal missions. We also envisage close partnerships with private firms in developing and demonstrating applications; the private sector will take the risks and make the investments needed to bring NGI research into commercial markets. This is similar to how the Internet itself moved from a DARPA/NSF research project to become the enormous commercial success it is today.

There are three goals for the NGI initiative:

The first goal is **Experimental Research for Advanced Technologies**. Under this goal, NGI researchers will develop and demonstrate the advanced network service technologies, namely, the technologies which provide functional capabilities to the network which are needed to support next generation applications. For example, high-quality team collaboration and network management to handle the routing, quality of service, and security demands for multicasting across thousands of high performance networks handling speeds that are 100 to 1000 times faster than today's Internet require network services that currently are not available with today's technology. These services must be richer in features, higher in performance, and able to be delivered at reasonable cost. The principal areas which will be developed and demonstrated include quality of service, security and robustness, network management, and protocols for collaborative and distributed applications environments.

The second goal is to weave the **Next Generation Network Fabric**. The NGI will develop a network of NGI sites -- universities, Federal research institutions, and other research partners -- for testing network technologies and new applications. This network fabric will be a broadly-based, distributed laboratory, delivering 100+ Mbps (more than 100 times typical current end-to-end capabilities) to at least 100 interconnected NGI sites demonstrating highly important applications. Ultra-high connectivity at 1000 times current Internet end-to-end performance (greater than 1 Gbps) will be achieved in smaller wide-area demonstration networks involving about ten NGI sites, and longer term research will be supported for terabit networks.

One key partnership which we have already established is with Internet2. Internet2 is the consortium of universities and their private sector partners who are committed to developing and demonstrating advanced applications for research and education. NGI's partnership with Internet2 will help us achieve NGI's Goal 2, developing a network of NGI sites -- universities, Federal research institutions, and other research partners -- for testing network technologies and new applications. NGI will provide partial funding for connectivity to the NGI network testbed via the NSF's very high speed Backbone Network System (vBNS). The mutual benefits are obvious: connectivity to the NGI will allow Internet2 researchers to work collaboratively with other university, government, and private researchers to develop, test, and demonstrate their applications; and the NGI will be able to test the robustness of its new networking technologies on a ready set of applications, in addition to those mission-specific applications developed by the participating agencies.

The third goal is to develop **Revolutionary Applications**. The NGI will demonstrate new applications that will help us meet important national goals and missions, ideally to include Federal agency mission applications, university and other not-for-profit applications and private sector applications. Potential application areas are likely to be

in health care, education, scientific research, national security, environment, government, emergency management and design and manufacturing.

The necessity of NGI

There are those who ask why are we making Federal investments in a next generation Internet when the private sector is clearly making the current generation Internet a commercial success?

Despite the dramatic and global growth of the Internet, we realize that there are still stiff challenges to be met if we are to fully harness its enormous potential. Exciting new applications for scientific research, telemedicine, lifelong learning, global electronic commerce and other disciplines remain momentarily out of reach. We are constrained by the capacity and capabilities of today's Internet technologies, which were not designed for either the scale or mode of its current use. Even though new applications and dramatic private investment have increased the Internet's capabilities, technological bottlenecks have sprung up throughout the system.

The Federal government is among those whose increased requirements for high-speed communications and advanced applications cannot be fully accommodated by the current technology. For example, rapid access to and manipulation of massive databases such as the NIH Visible Human, or the NASA images of Mars, would require moving a billion bits of information per second -- an impossible requirement for today's communication systems. Instead, these operations now can take hours or even days. Even the fastest operational DOD systems need six hours to send the kinds of information that would greatly inform battlefield commanders about a 100x100 mile battlefield. Rapid, advanced communications are equally important in the college classroom, just as they are in a military briefing room, which is why NSF's support of university research includes the high-speed Connections Program.

Clearly, there are abundant opportunities for anyone able to provide the right applications efficiently over cheap bandwidth with high-quality end-to-end performance. We expect that much of the innovation and investment needed to improve today's information infrastructure will come from the dynamic and highly competitive American companies --both old and new --that have expanded to meet this exploding new demand. Yet we have discovered that some of the constraints to the current-generation Internet go beyond a question of insufficient capacity; we are also facing limits to our understanding of network design, management and operations. The demands of a next generation Internet will require interconnection and management of increasingly larger and higher-speed networks, carrying differentiated services and enabling more sophisticated applications. Only through fundamental research can we take full advantage of the possibilities of increased capacity (speed), improved capabilities (quality of service and security) and revolutionary applications. With the NGI, we leverage Federal investment in advanced information technologies to provide this type of long-term, fundamental research.

There is a consensus among experts outside the Federal government, some of whom are testifying before the Committee today, not only on the need for NGI research, but also about the unique role of the Federal government in stimulating investment and collaboration for the NGI. Members of our Presidential Advisory Committee on High Performance Computing and Communications, Information Technology, and the Next Generation Internet have testified in previous Congressional hearings to share their endorsement of the Federal NGI research agenda. Endorsements of the NGI have also come from others, including chief executives from companies such as BBN Systems & Technologies, General Electric, Lucent Technologies, Cisco Systems, and academic leaders from institutions such as the University of Michigan and Pennsylvania State University. These statements of endorsement are available online at www.ccic.gov/ngi/endorsements.html. Additionally, the community of U.S. networking experts, including members of our Advisory Committee, came together with our Federal experts last May to define the collaborative research that is the core of the NGI. This workshop, sponsored by such industry groups as the Computer Research Association (CRA), Computer Systems Policy Project (CSPP), and Cross Industry Working Team (XIWT), concluded that the NGI is essential for Ausing the Internet's promise and... to accelerate the rate of future networking development. @ Workshop participants identified areas where government-sponsored initiatives could be helpful to the NGI, which the Federal NGI implementation team used to refine its plan. The workshop proceedings, Research Challenges for the Next Generation Internet, were published by CRA and are online at www.cra.org/main/cra.pubs.html

NGI Management

Some may express concerns about the overall management of the NGI and other large interagency research programs. In the past, such programs may have been cumbersome to manage, especially when agency priorities were not well coordinated with the overall program priorities. However, I would like to assure the Committee that we have in place the following management mechanisms that we believe will minimize any such problems:

- General coordination through the Committee on Computing, Information, and Communications (CCIC) of the National Science and Technology Council (NSTC)
- Annual budget crosscuts for high performance computing
- Program review by outside experts, collaborators and partners

CCIC Coordination

The NGI initiative focusses and augments research already underway within the large,

dynamic research programs coordinated by our CCIC. These programs are an outgrowth of the highly successful, Congressionally-chartered High Performance Computing and Communications (HPCC) initiative that was responsible for catapulting the United States into the era of teraop computers, gigabyte networks, and computation-intensive science and engineering applications. Communications research in advanced networking technologies and services, including the NGI, is coordinated by the CCIC's Large Scale Networking (LSN) working group. Attached to my testimony is an organizational chart of the CCIC programs, which is also online at www.ccic.gov/ccic/.

As with other interagency research activities that are coordinated by our CCIC, NGI research will be managed according to a strategy based on the following key principles: (1) cooperation and coordination among participating agencies, (2) a close relationship between the technology efforts within the NGI initiative and the large applications-level efforts of the agencies, and (3) leveraging existing execution mechanisms within the agencies. A senior interagency team comprised of key officials from Federal R&D agencies provides additional policy guidance and coordination across the research program areas for the entire CCIC enterprise. The CCIC's Large Scale Networking working group is responsible for NGI implementation strategy. Overall interagency coordination and support are provided by the National Coordination Office for Computing, Information, and Communications. This system of operation has worked successfully over the past five years. It has earned the respect of all the participating agencies because it has allowed each agency to hasten the achievement of their own mission objectives by leveraging their research investments and expertise in close collaboration with research organizations in other parts of the government. This professional team has a demonstrated track record of accomplishment that should enable it to succeed in the future.

Each CCIC agency supports individual components of the research program that are directly relevant to its specific mission. By collaborating in this interagency process, they advance not only their own missions, but the overall mission of the entire Federal program. Such is also the case with the NGI: participating agencies have specific mission needs for new networking technology, but cannot fulfill those needs on their own. Each brings specific skills, expertise, and/or applications needs to the collaboration table, and leverage these joint resources to achieve success. Here are the FY98 participating NGI agencies and their special expertise:

- **DARPA:** long-term, general expertise in networking research, general skill in high-end network technology and testbeds, experience in managing networks.
- **NASA:** experience in network management and in specialized network testbeds, strength in mission-driven applications involving high data rates, great strength in system engineering and integration.

- **NSF:** special relationships with the academic community, experience in network research and in managing networks, great strength in scientific applications.
- **NIST:** long experience in standards development, networking research, metrology, computer systems security, systems integration for manufacturing applications, and in testbeds involving many industrial partners.
- **National Library of Medicine (NLM)/National Institute of Health (NIH):** extensive experience in medical research; great expertise in health care applications.

Since the NGI is part and parcel of the larger LSN program of related research in high performance network communications, it will benefit from related research in other CIC agencies. The NGI will build directly, sometimes indirectly, on the advanced research for Federal networks such as the DARPA-led ATDnet, NSF's vBNS, DOE's Esnet, and NASA's NREN. These networks connect U.S. researchers and educators to information resources, computational resources, and scientific facilities, thus enabling and encouraging greater communication and increased collaboration.

Budget crosscuts

Each year, OSTP collaborates with OMB and the CCIC agencies to produce a crosscut of R&D funding to support our Federal objectives for computing and communications research. This congressionally mandated budget review started with the HPCC program and has evolved to become part of the CCIC's R&D portfolio. The annual crosscut permits us to review just how effectively we are leveraging the resources and expertise of CCIC agencies to accomplish the goals of our overall Federal R&D programs. Each year, our National Coordination Office for CIC produces a publication based on this crosscut, highlighting representative accomplishments, key research and development areas, and demonstrating their contribution to CIC research programmatic areas. I have submitted with my testimony this year's brochure summarizing the FY98 budget activity (www.ccic.gov/pubs/bro98/).

External review

Additionally, OSTP ensures that management of all our CCIC programs, including the NGI, are reviewed by experts from outside the Federal government. I previously mentioned the thorough review given the NGI by our newly appointed Advisory Committee and the networking experts who attended the CRA workshop. The Advisory Committee will provide expert advice and wise recommendations on future directions for our Federal investments in high-performance computing and communications and information technology. Just last Thursday, the President named four new members to our Advisory Committee, bringing the total membership to twenty-five. We are proud

that this Committee of the nation's leading experts in these areas represents the long term interests of business, communications, computation, universities, libraries, and information technology from all geographic regions of the United States.

We are also working closely with the community of U.S. networking experts from the private sector and academia, not only to review our NGI research agenda, but also to establish effective partnerships. Such partnerships are crucial to the success of the NGI research program, because it is applications-driven. In other words, the Federal agencies participating in the NGI are developing networking technologies to support a new generation of high-speed, high-bandwidth applications. Some of those applications are mission-specific to the agencies themselves. But many other applications are being developed by academia and industry. By working closely with these groups, NGI researchers will be able to test new technologies against a broad range of applications' networking requirements. And participation by the private sector will allow more efficient transfer of the results of NGI research into commercial applications and services.

Conclusion

Mr. Chairman and Members of the Committee, I hope this overview has provided you with better understanding of how we expect to manage and coordinate this exciting new program. Although the initiative weathered some initial confusion about its objectives, we have benefitted from ideas from the Congress to generate a better understanding of its intent. And we are quite pleased by the results: a growing bi-partisan consensus on the importance of NGI research, accompanied by first year funding of \$85 million (of the President's requested \$105 million). We are now finalizing our Implementation Plan to reflect these new funding levels, and soon will embark on this research program which will allow the U.S. to continue to reap the benefits of the Information Age well into the 21st century. We look forward to not only working with you, but incorporating your best ideas to ensure that the NGI and all our Federal R&D programs are well managed so as to generate the greatest possible public benefit from our Federal investments.

Thank you, Mr. Chairman.